

# Juvenile Salmon Usage of Nearshore Habitats along City of Seattle Marine Shorelines

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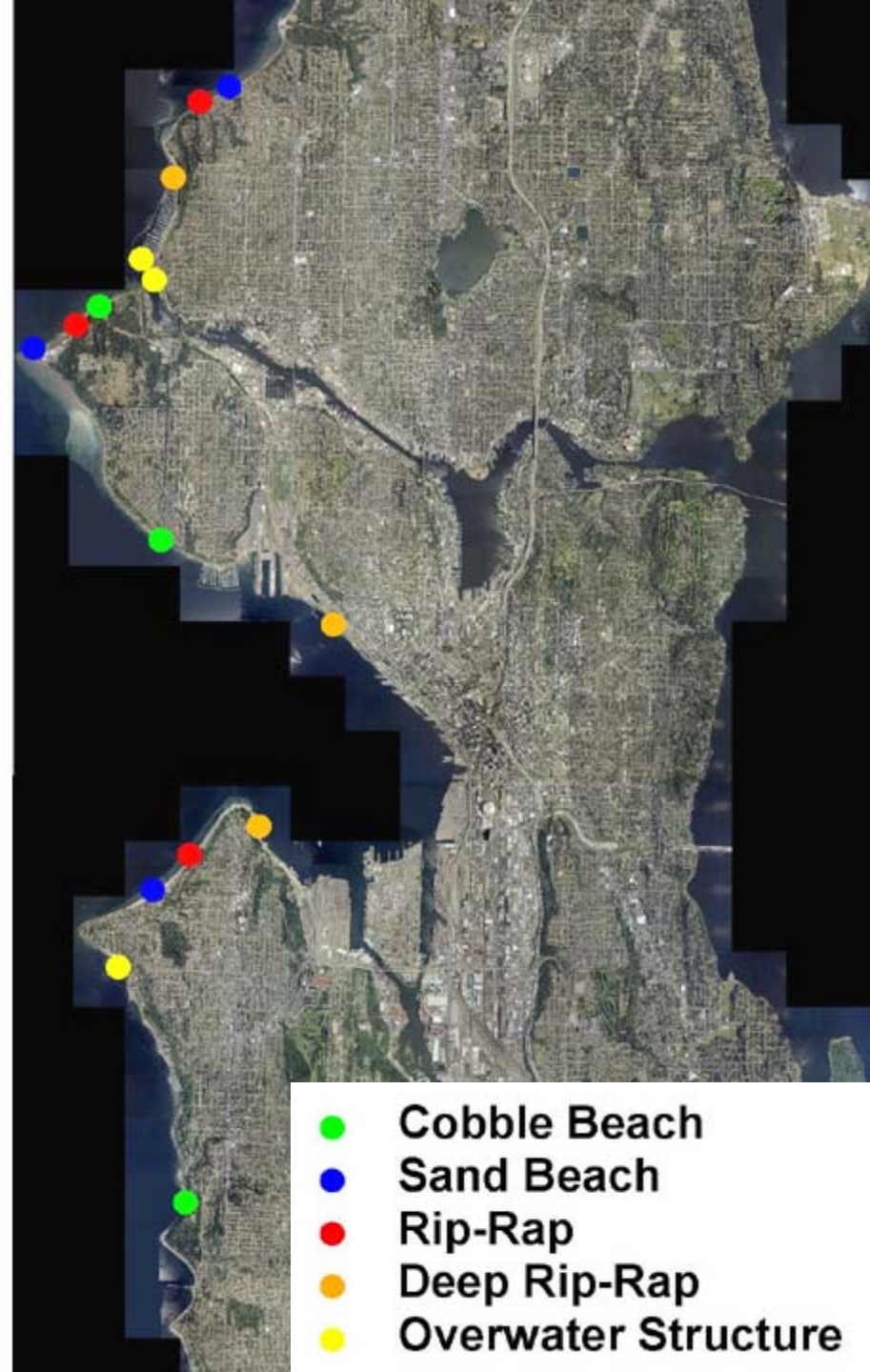
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Funded by the Seattle Public Utilities  
Department



- Cobble Beach
- Sand Beach
- Rip-Rap
- Deep Rip-Rap
- Overwater Structure



## **Main Objective:**

**Quantify the abundance and behavior of juvenile salmonids and other fishes directly along marine shoreline habitat types.**





## **Sampling Methods: High tides 5/12 - 8/1/03**

**Spring Tides: Enclosure nets and snorkeling - sand, cobble, riprap**

**Neap Tides: Snorkeling - all sites**



### Enclosure Nets (n=48):

- Samples entire water column
- Minimal problems with obstacles on substrate
- Holds fish for 2.75 hours, good for fish diet analysis
- Mesh size not good for small forage and larval fish
- Time and labor intensive

### Snorkeling (n=442):

- Fish not captured
- Dependent on water clarity
- Onsite specific behavior and location patterns
- Good at small forage/larval fish and rare fish
- Not so good at juvenile flatfish
- Ease of replication



## Pros and Cons





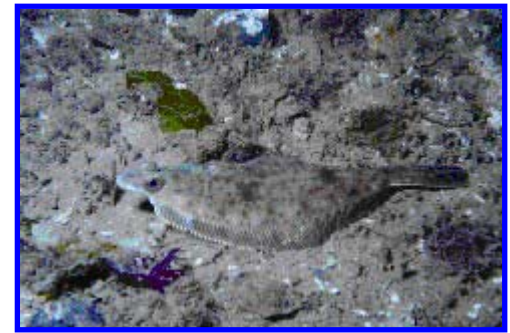
## **All Results are PRELIMINARY!:**

**First detail fish densities from above 3 habitat types (modifications just to intertidal), then include the 2 below (modifications extend into subtidal).**

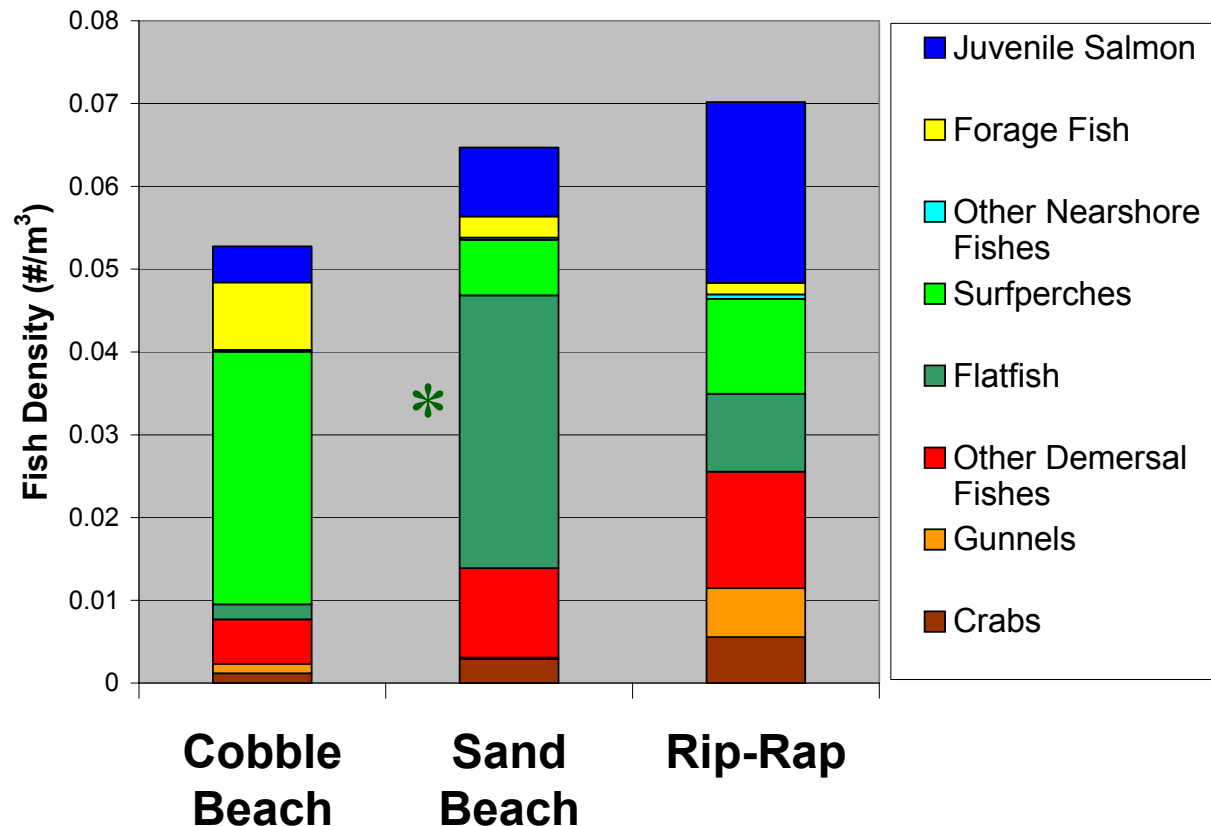


# Fish Densities:

Between cobble beaches, sand beaches, and rip-rap that ends at the high intertidal, we see minimal differences - all in bottom fishes.



Enclosure Nets: ↑ Flatfish (juv. English Sole) at Sand Beaches



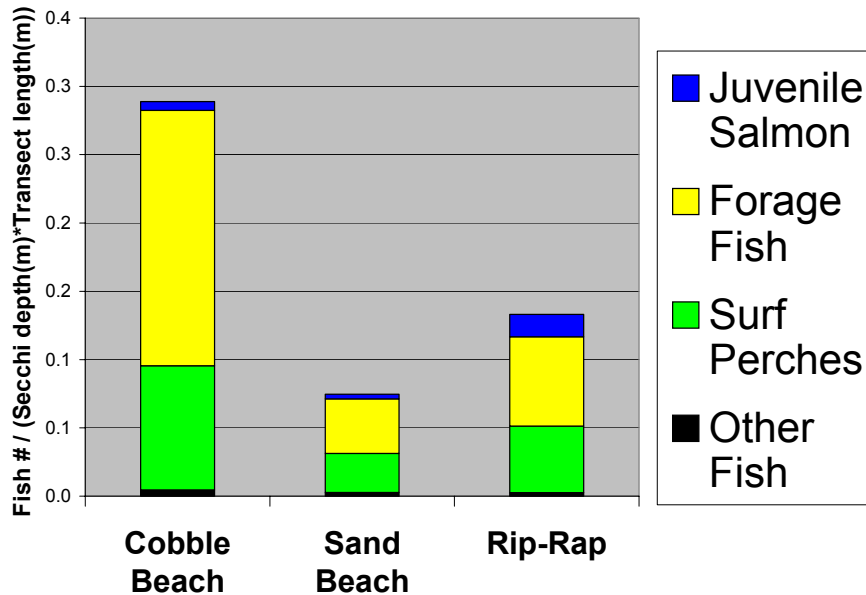
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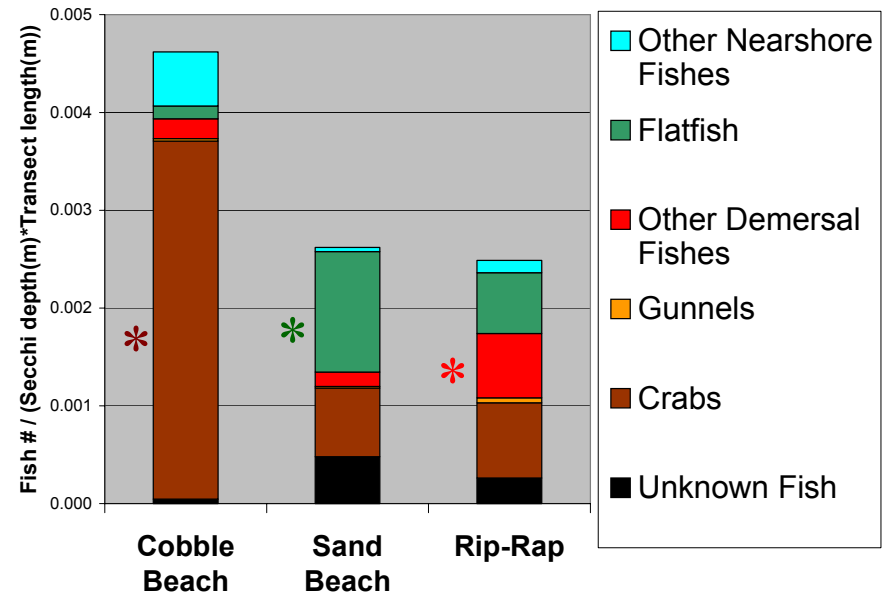


Snorkeling: ↑ Crabs at Cobble Beaches, ↑ Sculpins at Rip-Rap

**Abundant Fish**



**Less Abundant Fish**



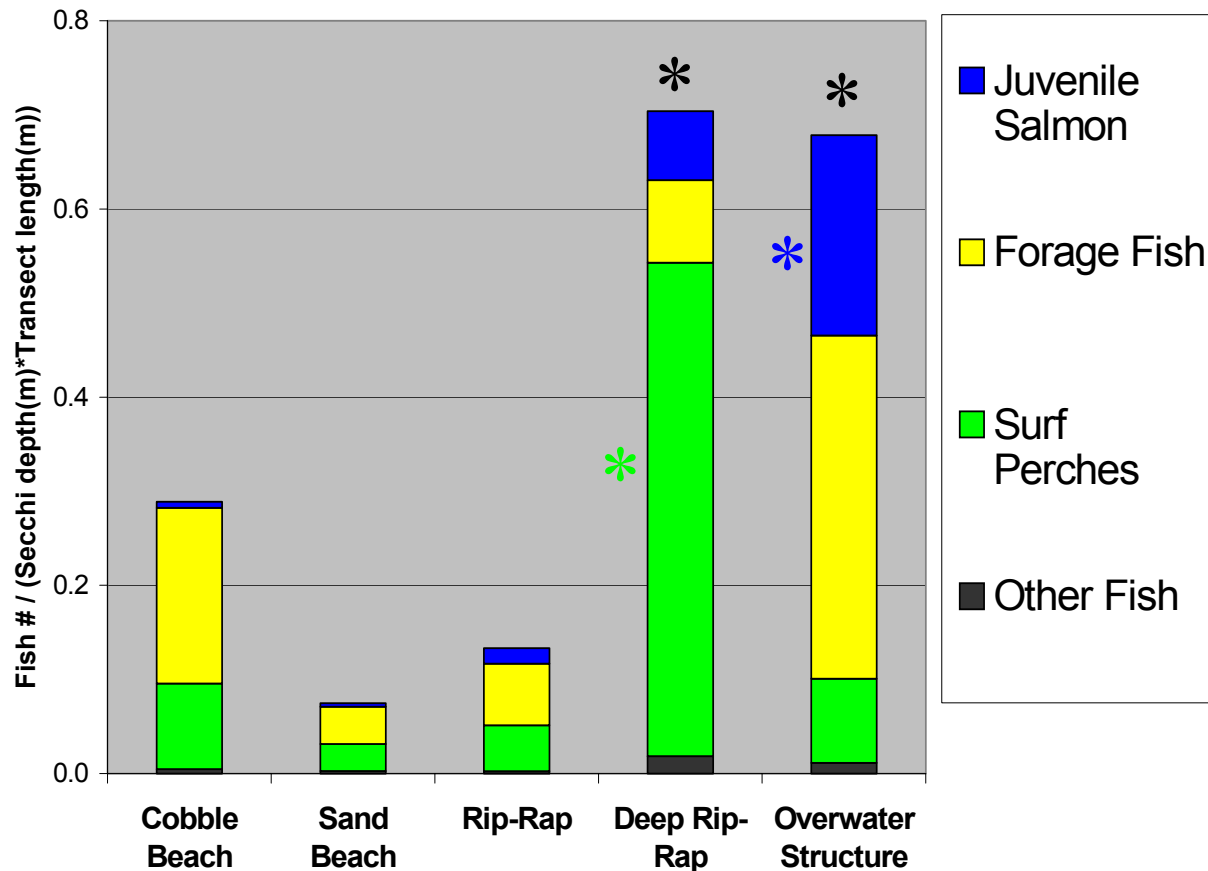
# Fish Densities:

When shoreline modifications extend into the subtidal, we see more differences - in pelagic fishes.

Snorkeling: ↑ Overall at Overwater and Deep Rip-Rap,  
↑ Juvenile Salmonids at Overwater, ↑ Surfperches at Deep Rip-Rap



Abundant Fish



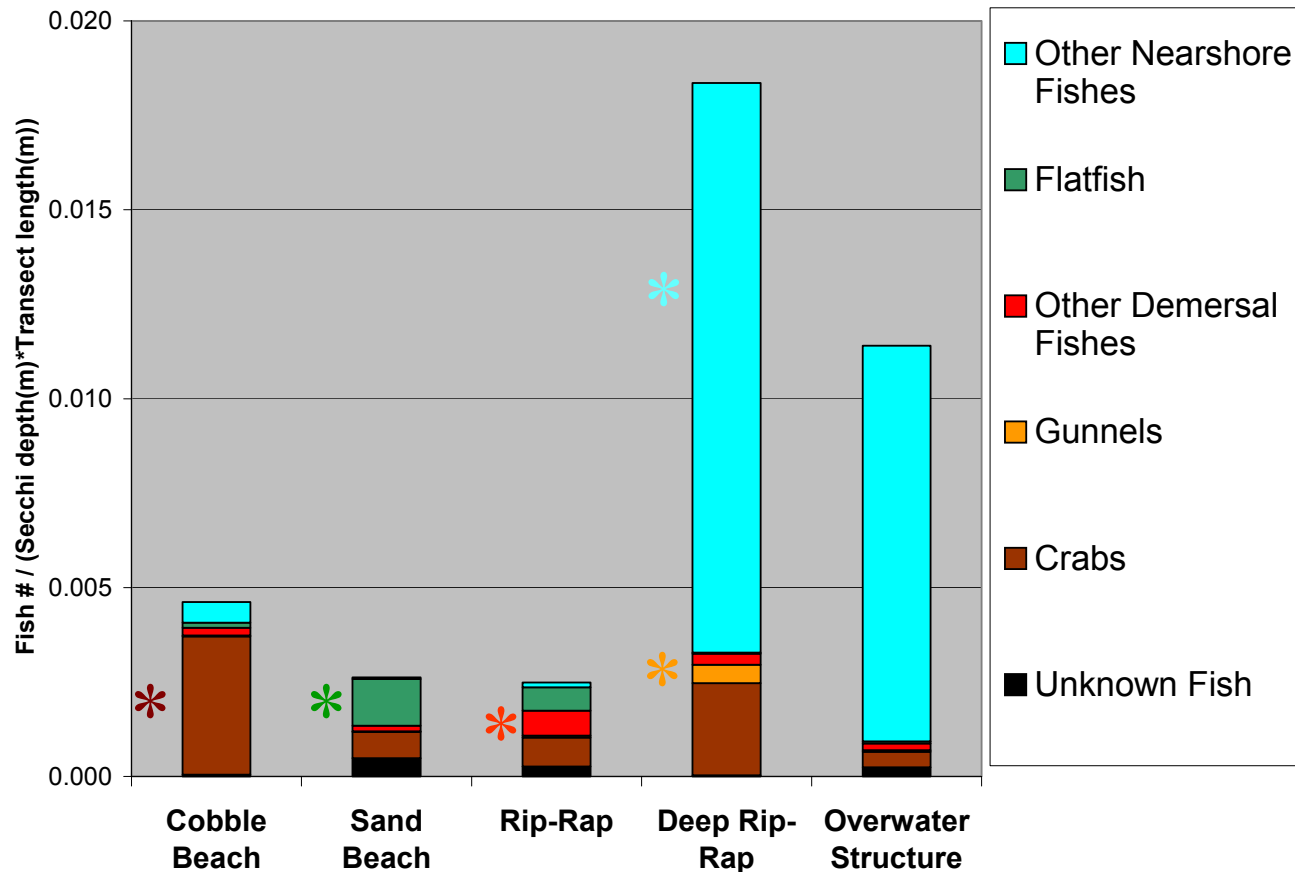
# Fish Densities:

When shoreline modifications extend into the subtidal, we see more differences - in pelagic fishes.

Snorkeling: ↑ Other Nearshore Fishes and Gunnels at Deep Rip-Rap



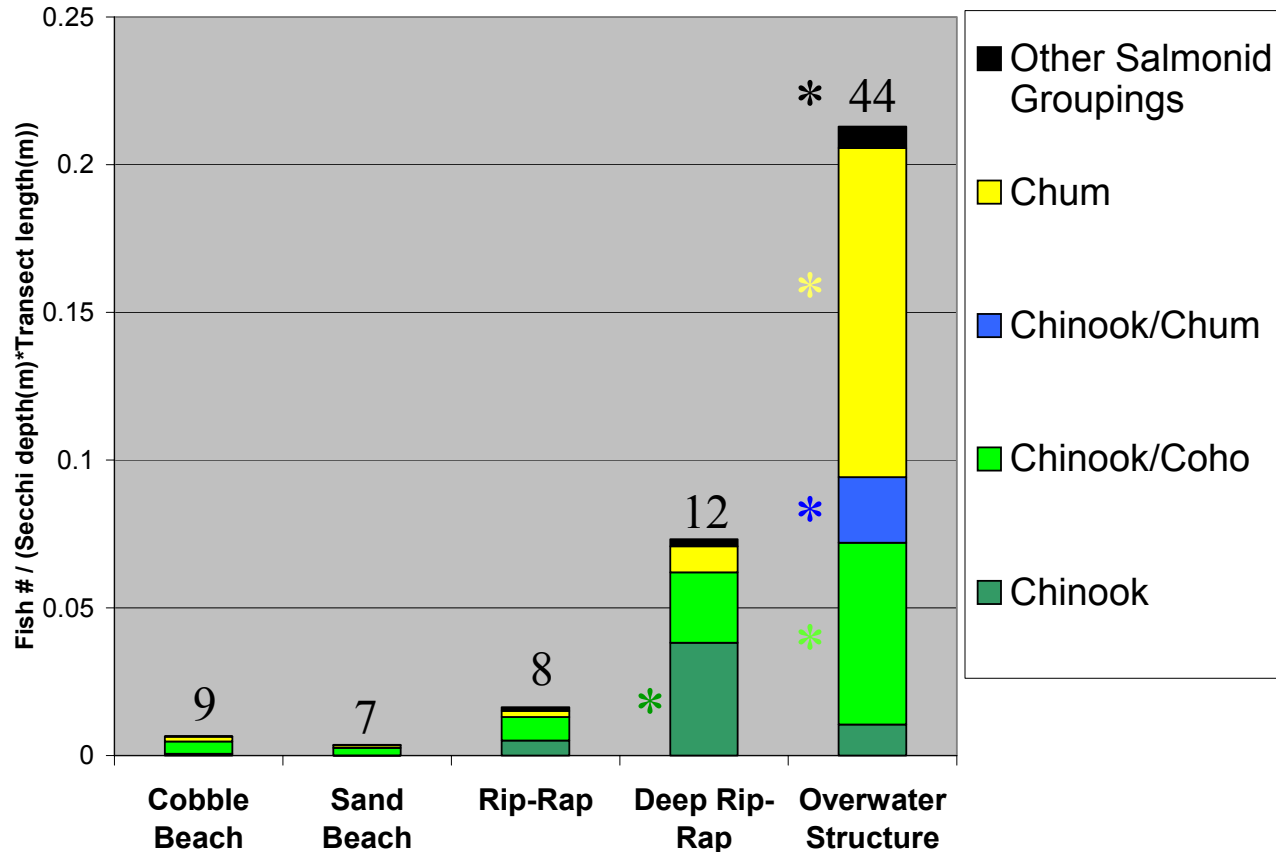
## Less Abundant Fish



# Salmon Densities and School Sizes:

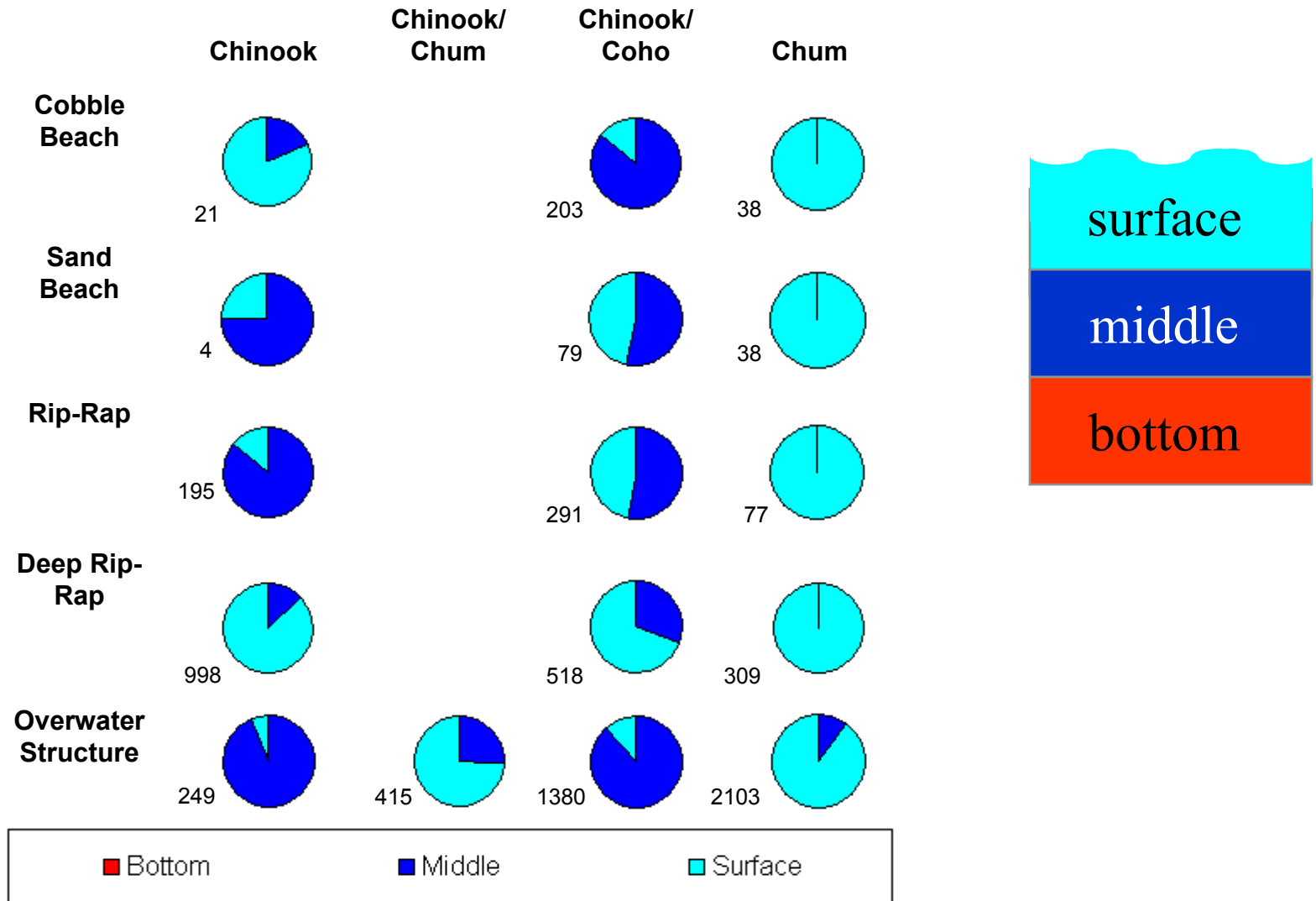
When shoreline modifications extend into the subtidal, we see differences in juvenile salmonids.

Snorkeling: ↑ Juvenile Salmonid species groupings at Overwater and Deep Rip-Rap, also greater school sizes at Overwater (numbers above bars)



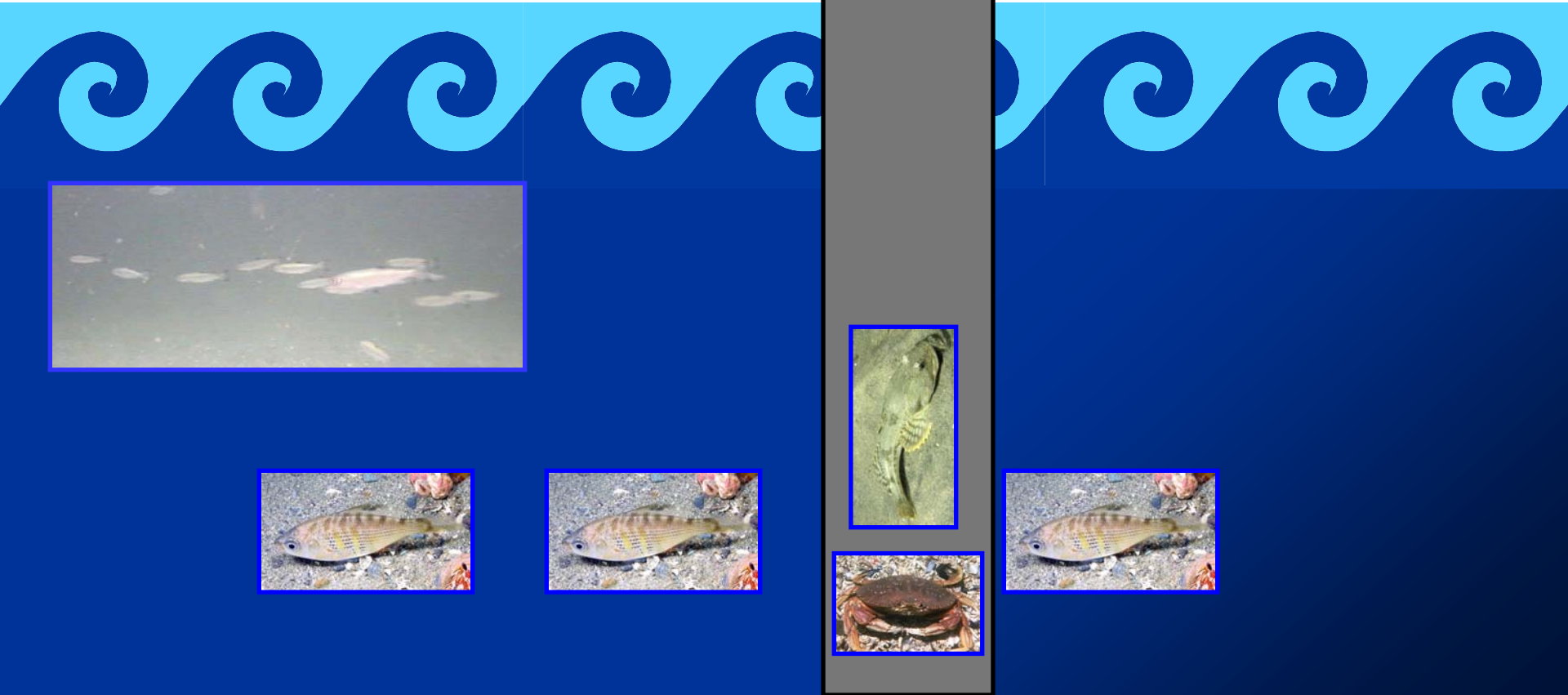
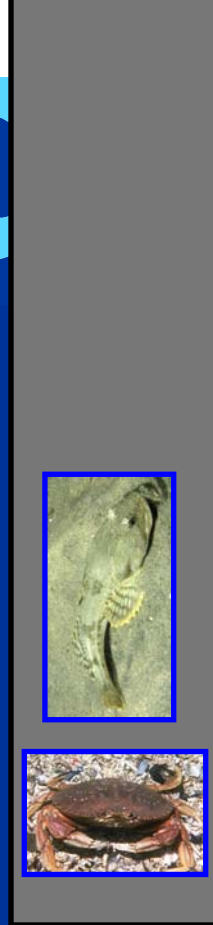
# Salmon Locations in Water Column:

Deep Rip-Rap and Overwater Structures can affect positions.



## Fish Location:

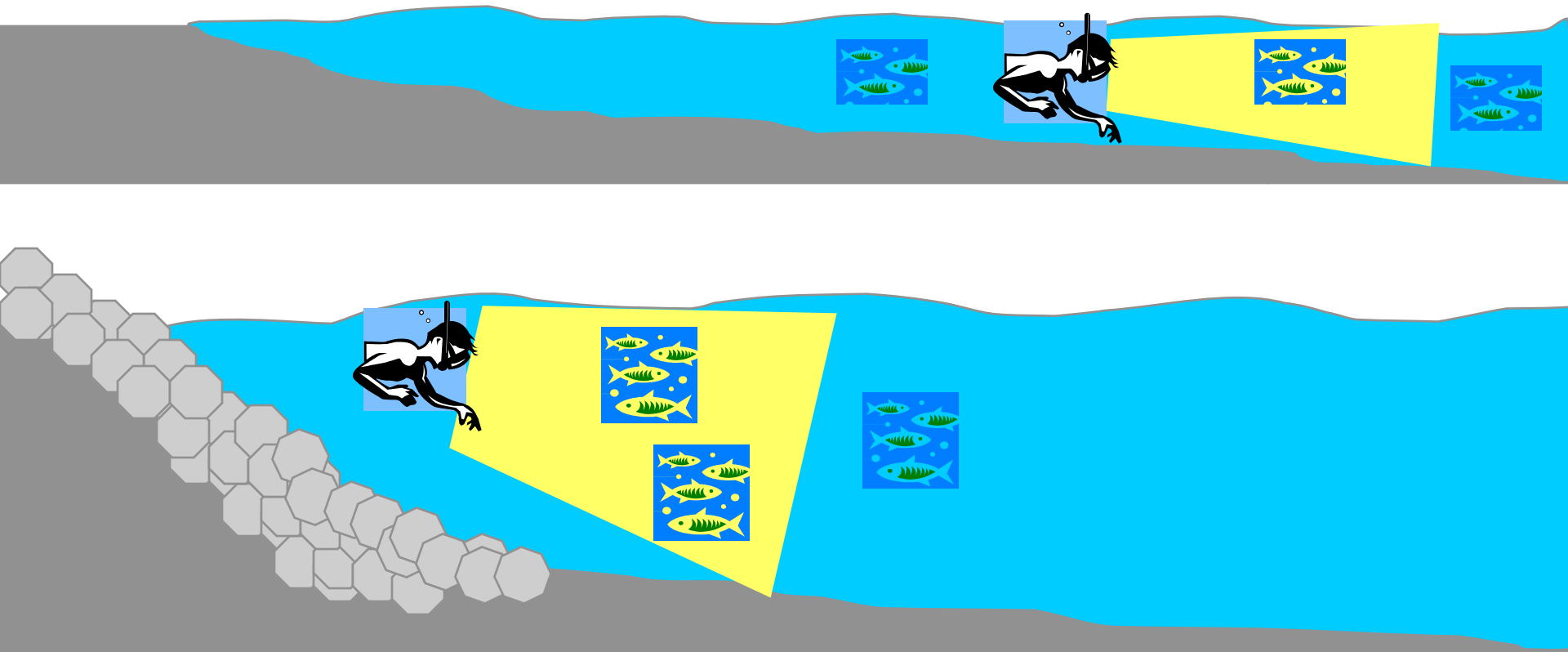
**Juvenile salmonids found 70% > 1m away from edge,  
or 30% at edge, rare underneath Overwater Structures.**



Habitat Type	Average Transect Distance from Shore (m)	Average Water Depth at Fish (m)	Average Secchi Depth (m)	Surface Salinity (ppt)
Cobble Beach	17.2 <sup>a</sup>	1.6 <sup>a</sup>	4.3 <sup>a</sup>	28.7 <sup>a</sup>
Sand Beach	12.9 <sup>b</sup>	1.7 <sup>a</sup>	4.8 <sup>ab</sup>	28.7 <sup>a</sup>
Rip-Rap	7.7 <sup>c</sup>	1.7 <sup>a</sup>	4.7 <sup>a</sup>	28.8 <sup>a</sup>
Deep Rip-Rap	4.8 <sup>d</sup>	2.4 <sup>b</sup>	5.9 <sup>c</sup>	27.5 <sup>a</sup>
Overwater Structure	3.4 <sup>d</sup>	4.4 <sup>c</sup>	5.4 <sup>bc</sup>	23.7 <sup>b</sup>

# Habitat Measurements:

**Shoreline modifications truncate the shallow water zone, gradual slope is lost. Pelagic fish that are typically spread-out along a large area may be forced to inhabit deep water directly along shore.**

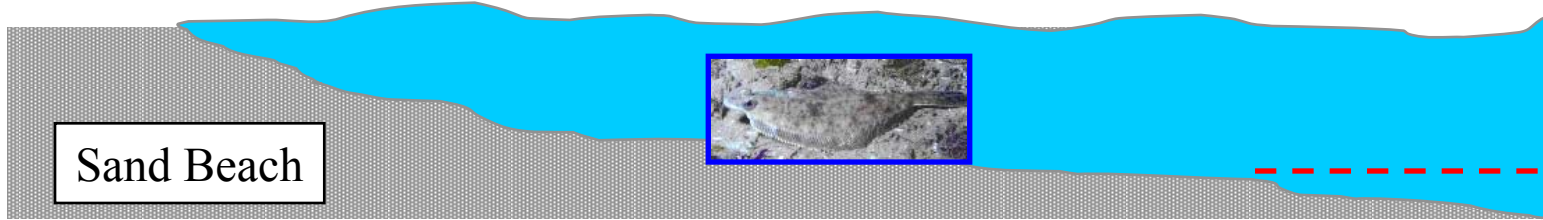




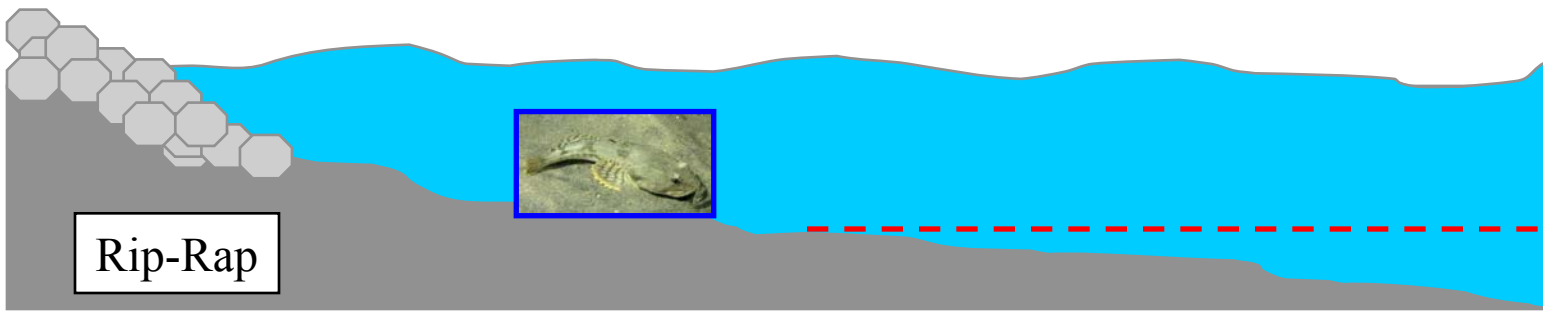
Cobble Beach



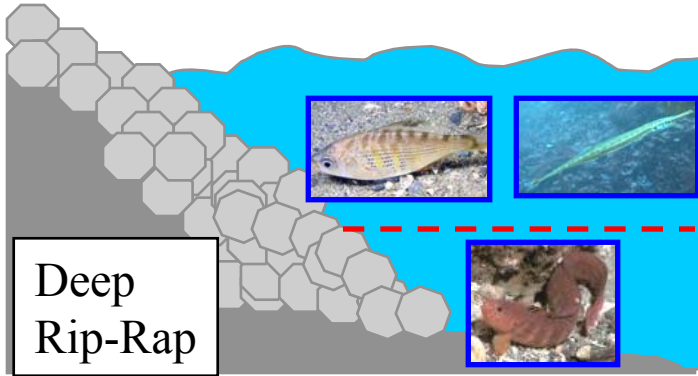
Sand Beach



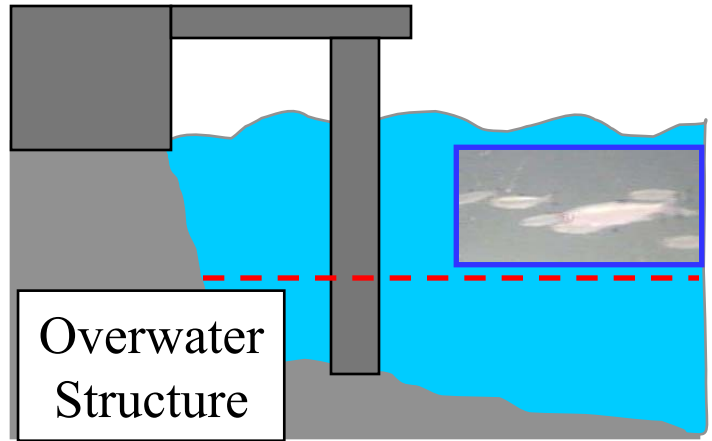
Rip-Rap



Deep  
Rip-Rap

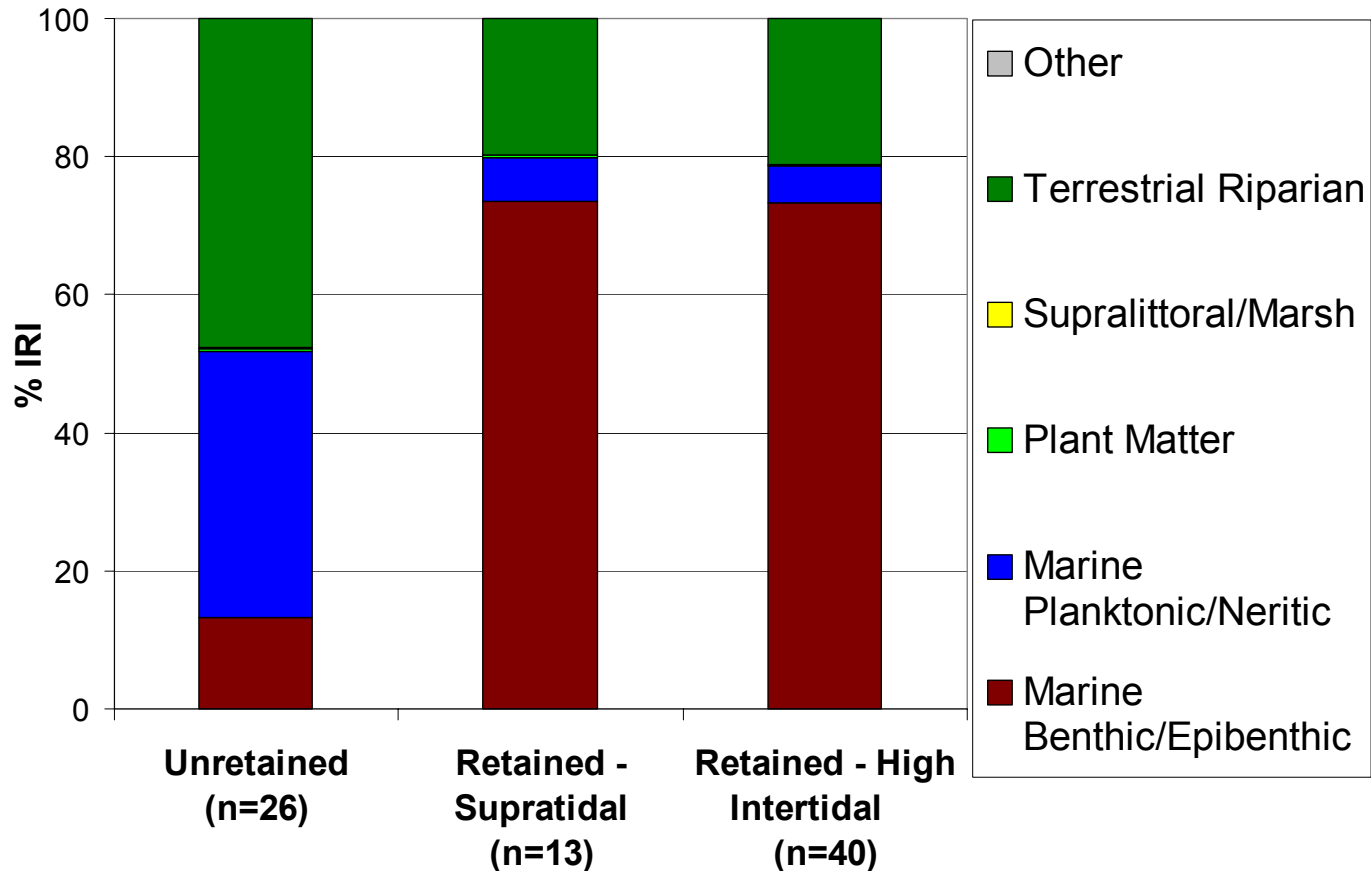


Overwater  
Structure



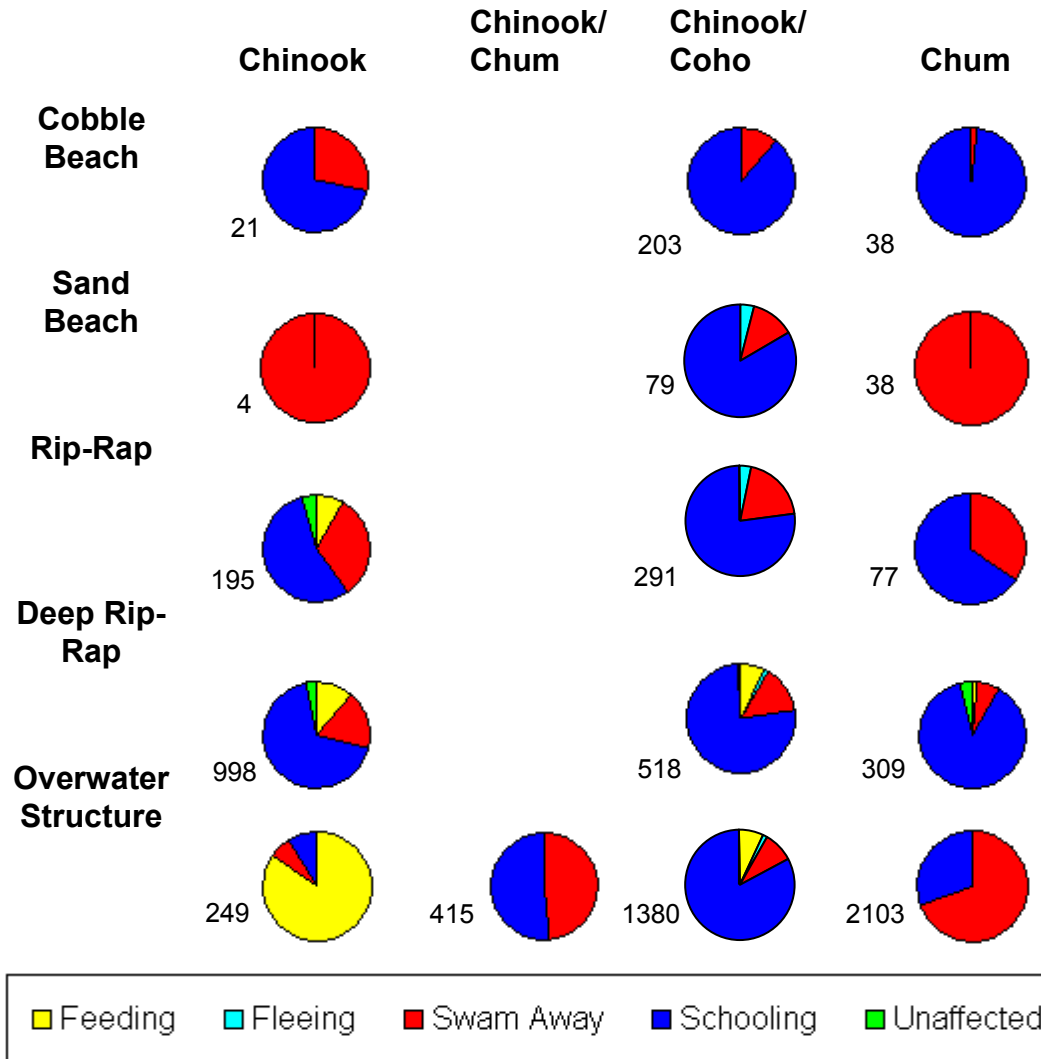
# Diet Analysis:

Gastric lavage of juvenile chinook shows less terrestrial/riparian input (insects) at sites with retaining structures at intertidal or supratidal.



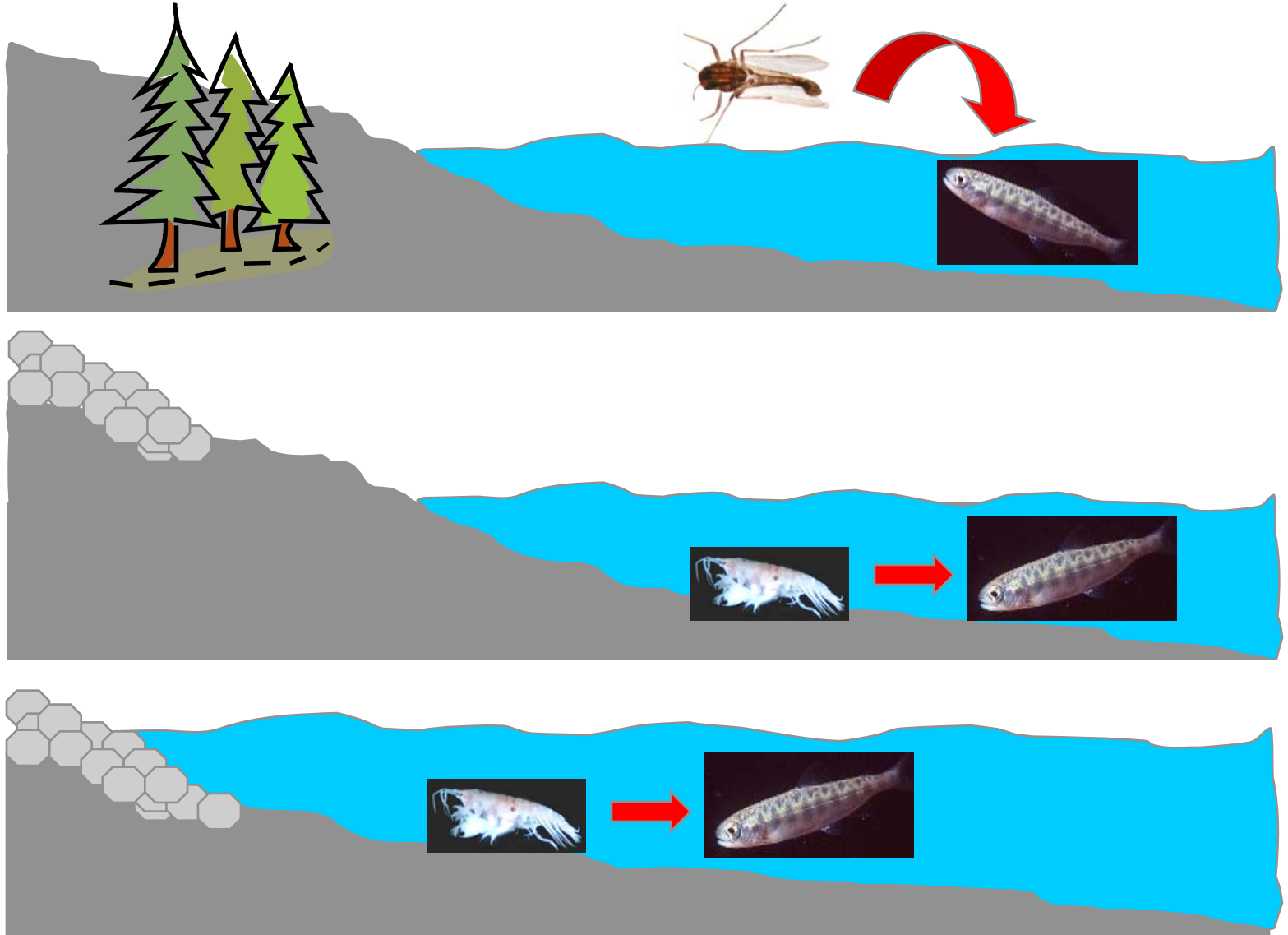
# Salmon Behaviors:

**Mostly schooling or swimming away. Fish are feeding on neuston at modified habitats, but getting less terrestrial input = limited.**



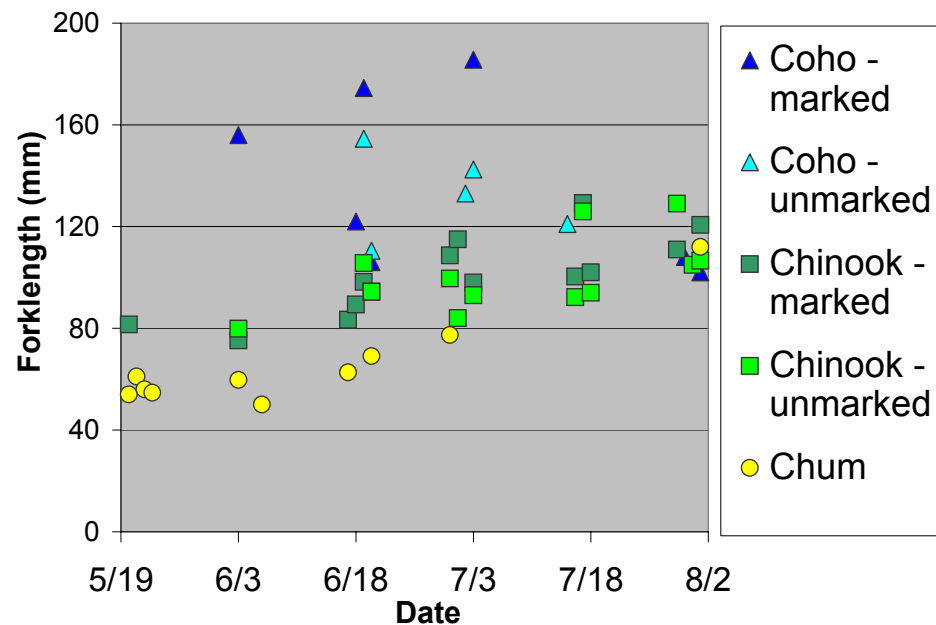
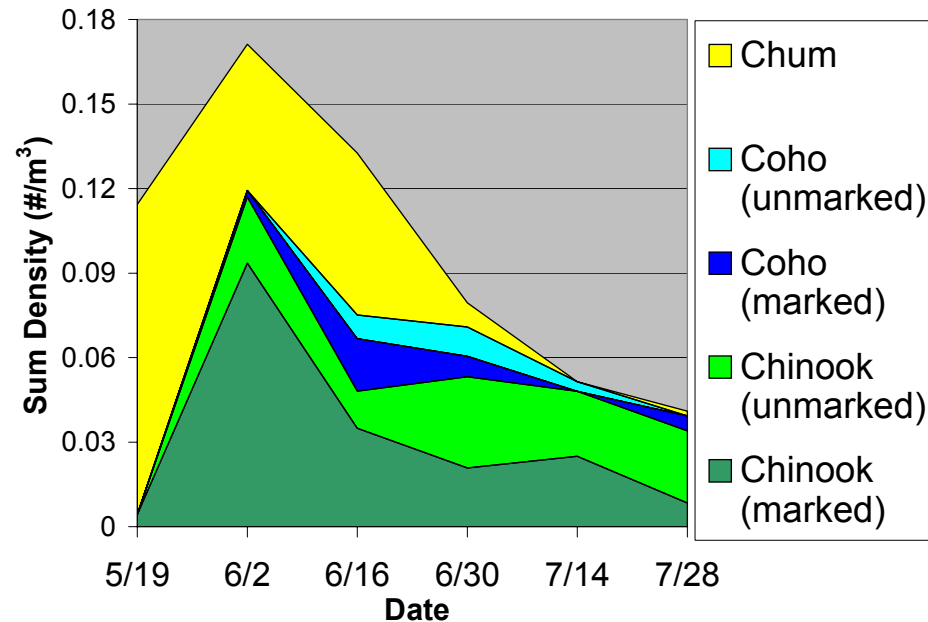
# Prey Resources:

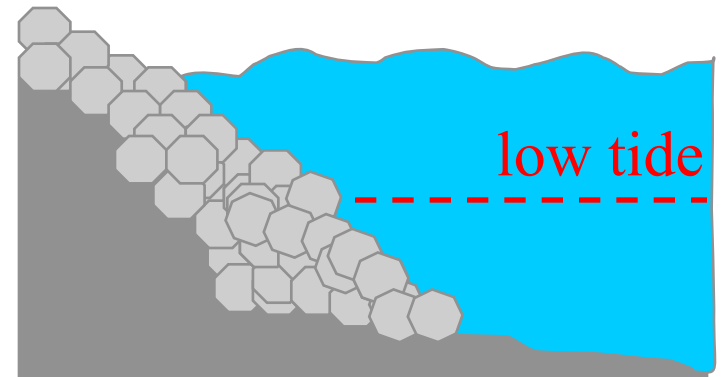
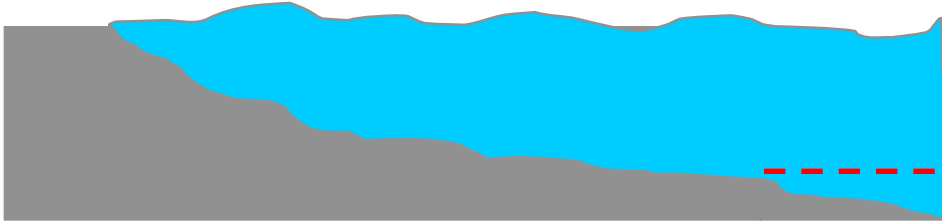
Unretained shorelines have a greater input of terrestrial insects into the diets of juvenile chinook salmon.



# Timing and Size:

- As compared to Lake Washington: juvenile chinook avoid armored banks (Roger Tabor).
- Juvenile chinook are larger and more pelagic in marine waters, less dependent on shallow water (Casey Rice).
- Differences are related more to indirect rather than direct effects of shoreline modifications, such as changes in water depth, substrate, and shoreline vegetation.





## Concluding Remarks:

- Shoreline modifications have the greatest effect on marine nearshore fish communities when they extend from the supratidal through the subtidal.
- Cumulative effects could be important, as 84-97% of the shoreline is modified by retaining structures.

## Future Research:

- Further examine the effects of shoreline modifications on ecological communities in regard to bank type, tidal height, and salinity regimes.
- Look at landscape level patterns, especially in areas with high degrees of alteration.
- Investigate specific characteristics of Overwater Structures, such as density, size, distance extending from shore, height above water, etc.

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Pilot Study Report #301: [www.fish.washington.edu/Publications/frireps.html](http://www.fish.washington.edu/Publications/frireps.html)

Final Report: due March 30, 2004

Ongoing Research:

1. Ferry Terminals
2. Monitoring of Salmon Bay Natural Area

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